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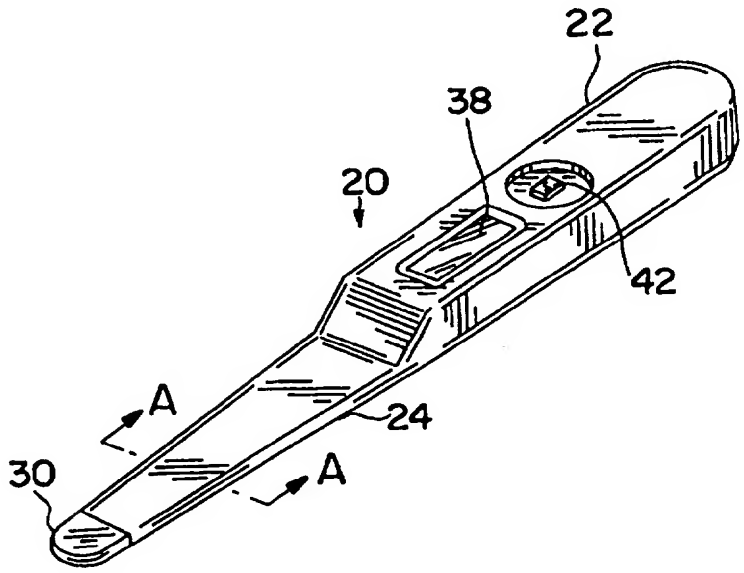
(54) Title: ELECTRONIC THERMOMETER

(57) Abstract

A user-friendly electronic thermometer (20) comprises a substantially flat probe (24) containing a temperature sensor (26) and extending from a housing (22) or a shell that holds an electronic processor and a digital display read-out (38). An electrically conductive path exists between the electronic processor and the temperature sensor (26). Preferably, the flat probe is made of a flexible material.



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ELECTRONIC THERMOMETER

Technical Field of the Invention

The present invention relates to an electronic thermometer for detecting and digitally displaying a body temperature. More particularly, the present invention pertains to an electronic thermometer with a user-friendly probe.

Background of the Invention

Electronic hand-held thermometers for medical use have been commercially available since the 1970s and offer many advantages over mercury glass thermometers. A typical electronic thermometer comprises a temperature-sensing element that converts temperature information into an electric signal and, computing and display elements for converting the electric signal into a digital signal, computing the digital signal, and displaying the determined temperature. A battery for supplying power to these components is also present. The aforementioned elements are housed in a casing.

In use, the temperature detected by the sensor is converted to a visually discernible digital display by an electronic circuit.

Efforts at improvement on this basic design have resulted in thermometers with probes made of flexible material. A flexible probe section allows for oral temperature measurement that is more comfortable for the patient. Other improvement efforts are reflected in various patents. For example, U.S. Patents No. 4,729,672 and No. 5,165,798 describe assembly structures or elements for improved water-tight seal. U.S. Patent No. 5,013,161 is directed to a relatively softer covering material or coating for a thermometer.

Available electronic thermometers still suffer from significant drawbacks, however. In particular, the

tubular shape and size of probes of conventional electronic thermometers are not well suited for oral temperature measurement. The conventional probe, a thin, hollow, cylinder with pointed tip, does not conform well to the shape of the mouth of a patient. Upon insertion into the mouth, the pointed tip often jabs mouth tissue, causing pain and discomfort. While waiting for the probe tip to reach mouth temperature, the tip must be held under the tongue, where the point continues to cause discomfort.

This pointed-tip design is a particular problem for small children because the probe is inserted into their mouth typically by a parent or a nurse.

Furthermore, the conventional probe shape coupled with the small size of the probe relative to the housing section makes it difficult for patients to support the housing during measurement. Under the weight of the housing hanging outside the mouth, conventional thermometers easily slip out. This problem leads to both painful straining and frequent movement of the probe, which can result in an inaccurate temperature measurement.

Thus, there continues to be a need for a more user-friendly electronic thermometer.

Accordingly, it is an object of this invention to provide an electronic thermometer that can be comfortably inserted and held in a suitable body cavity, particularly the mouth.

Summary of the Invention

A user-friendly electronic thermometer comprises a substantially flat, leaf-like or spatulate probe containing a temperature sensor and extending from a housing or a shell that holds or envelops an electronic processor and a digital display operatively associated with the temperature sensor for converting

the temperature of the sensor to a digital display read-out. An electrically conductive path exists between the electronic processor and the temperature sensor. Preferably, the flat probe is made of a flexible material.

There are other advantages and features of the present invention which will be more readily apparent from the following detailed description of the preferred embodiment of the invention, the drawings, and the appended claims.

Brief Description of the Drawings

In the drawings,

FIGURE 1 is a perspective view of an electronic thermometer embodying the features of the present invention;

FIGURE 2 is a top plan view of the thermometer of FIGURE 1;

FIGURE 3 is a side elevation view of the thermometer of FIGURE 1;

FIGURE 4 is an enlarged vertical cross-sectional view of the electronic thermometer of FIGURE 1;

FIGURE 5 is an enlarged radial sectional view of the thermometer, taken along the plane A-A in FIGURE 1;

FIGURE 6 is a perspective view of an electronic thermometer according to another embodiment of the present invention;

FIGURE 7 is a side view of the thermometer of FIGURE 6;

FIGURE 8 is a perspective view of an electronic thermometer according to yet another embodiment of the present invention.

Description of the Preferred Embodiment

While this invention is susceptible of embodiment in many different forms, there are shown in the drawings and will be described herein in detail specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the claimed invention and is not to be limited to the specfic embodiments illustrated.

As shown in FIGURES 1-4, one preferred embodiment of an electronic thermometer 20 according to the present invention comprises an elongated shell or housing 22 having a flat, spatulate probe 24 extending outwardly from the housing 22. The probe 24 can be solid or hollow, as desired, and preferably is tapered outwardly away from the housing 22 in a distal direction as shown. A temperature sensor 26 is located at the distal end of the probe 24.

The temperature sensor 26 (FIGURE 4) includes a temperature-responsive element 28 such as a thermistor or thermocouple for converting ambient temperature into an electric signal. A sensor cap 30 at the distal end of the flat probe 24 surrounds and protects the temperature-responsive element 28. The probe cap 30 preferably is made from a thermally conductive material such as stainless steel, aluminum or the like. A potting material 32 fills space defined by the sensor cap 30, the temperature responsive element 28, and the distal end of the probe 24.

The temperature-responsive element 28 is electrically connected by conductors 33 and 34 to an electronic circuit 35, which includes an electronic processor 36 and a digital display 38, operably associated therewith. The electronic processor 36 converts electric signals from the temperature-

responsive element 28 into digital signals. The digital display 38 serves to display a numeric read-out of the temperature detected at the temperature sensor 26.

Conductors 33 and 34 preferably are leads or wires, although it is possible to use other forms of conductive materials and means to provide electric communication between the temperature-responsive element 28 and the electronic circuit 35. In one preferred embodiment (FIGURE 5), this electric communication is achieved by two metal strips 133 and 134 carried in the probe 124 that can also be utilized to modulate the flexibility of the probe 124.

A power source 40, preferably a battery, energizes the electronic circuit 35. A switch 42 controls electrical connection between the power source 40 and the electronic circuit 35.

Numerous circuits and displays suitable for electronic thermometers are commercially available and do not form a part of this invention. The circuit arrangement described herein is exemplary of these many possibilities.

A key feature of the present invention is the ergonomically-correct shape of the probe. Because of this, the electronic thermometer of the present invention is more comfortable for both oral and axiallary temperature measurements than thermometers heretofore available. Also, because of the present leaf-like or spatulate shape of the probe, the thermometer of the present invention, when placed either in the mouth or the armpit, can be more easily retained by the patient as the temperature measurement takes pace.

As shown in the FIGURES, the probe of the present thermometer is spatulate in shape, substantially flatter and wider than the probes of thermometers in the

prior art. Preferably a major portion of the flat probe has a cross-sectional width-to-thickness ratio of at least about 3, more preferably at least about 5. Because of the spatulate shape of the probe, the distal end of the probe can be rounded to provide a blunted tip. This blunted-tip feature minimizes the likelihood of inadvertent poking and subsequent tissue irritation possible with the pointed-tip probes of thermometers of the prior art.

In one preferred embodiment of the present invention, the probe of the thermometer is flexible. This feature allows the thermometer to flex and conform to the shape of the patient's mouth or axial cavity, further minimizing the likelihood of tissue irritation. A flexible probe is also preferred because the probe shape can adjusts in response to patient movement without undesirable movement of the probe sensor.

As another feature attributable to the probe shape, the present thermometer can be more easily retained in the mouth or the armpit as the temperature measurement takes pace. Given a larger size, flatter profile, and greater surface area than heretofore available probes, the present probe, when inserted, better supports the portion of the thermometer outside the mouht or armpit. The flatter profile and larger surface area of the present probe provides greater sliding and slipping resistance within the mouth and axial cavity. The larger size provides greater leverage to control the weight of the thermometer housing.

In one preferred embodiment of the present invention, the surface of the probe is provided with a non-slip texture, i.e. with a surface roughness that facilitates oral retention of the probe even when wet. This feature provides enhanced slip resistance to the probe, permits a wider choice of materials of

construction, and therefore enhances reliable temperature measurements.

To further enhance oral temperature measurement, the flat probe of one preferred embodiment of the present invention, thermometer 220, is equipped with a protuberance or ridge 260 suitable for engagement by the teeth, as shown in FIGURES 6 and 7.

While the shape of the housing or shell 22 is elongated and substantially rectangular in cross-section, this is representative of the many possible housing shapes. In one preferred embodiment, electronic thermometer 320 (FIGURE 8), the housing 322 is more rounded in shape. The housing or shell 22 can be rigid or flexible, as desired.

In a particularly preferred embodiment the shell or housing 22 and probe 24 are both made of a moldable plastic material. Housing 22 and probe 24 can be unitary or can be joined together by a suitable method such as with an epoxy adhesive, a solvent-based adhesive, or by ultrasonic welding. Alternatively, the shell and probe may be molded as a one-piece, semi-soft or elastic envelope that encapsulates the sensor and working circuitry. The electronic circuit 35 with the processor 36 and the display 38 are contained within the shell or housing with a cable extending into the probe and providing electrical connection to the sensor contained therewithin.

A wide variety of materials are suitable for making the thermometer structure. These materials include metals and plastics without limitation that all of the structural elements be made of the same material. For example, the probe can be made of soft or semi-soft or pliant plastic, and the shell or housing can be made of metal, e.g. as a casting. With respect to non-metals, injection molded polymers such as polystyrene,

polyethylene, polypropylene and acrylonitrile-butadiene-styrene copolymers (ABS) are desirable.

If a flexible structure is desired, a wide variety of flexible or pliant materials is suitable. These include natural rubber, synthetic rubber, thermoplastics including thermoplastic elastomers, combinations thereof, as well as thermosets such as resilient foam. Thermoplastics such as polyvinyl chloride are preferred from the standpoint of ease of manufacture.

I CLAIM:

1. A thermometer suitable for measuring the temperature of a patient and comprising:

an elongated housing;

a flat, substantially spatulate, probe mounted to said housing, extending outwardly from one end thereof, and adapted to be received within a body cavity of the patient;

a temperature sensor at the distal end of said flat probe;

a digital display in said housing; and

an electronic processor in said housing operably associated with said temperature sensor and with said digital display to convert a temperature value detected by said temperature sensor into a read-out on said digital display.

2. The thermometer in accordance with claim 1 wherein a major portion of said flat, substantially spatulate probe has a cross-sectional width-to-thickness ratio of at least about 3.

3. The thermometer in accordance with claim 1 wherein said flat, substantially spatulate probe has a width tapered outwardly away from said housing.

4. The thermometer in accordance with claim 1 wherein said flat, substantially spatulate probe is flexible.

5. The thermometer in accordance with claim 4 wherein said flat, substantially spatulate probe is made from a pliant material.

6. The thermometer in accordance with claim 4 wherein said flat, substantially spatulate probe is made from an elastomeric material.

7. The thermometer in accordance with claim 1 wherein the external surface of said flat, substantially spatulate probe has a non-slip texture.

8. The thermometer in accordance with claim 1 wherein said flat, substantially spatulate probe is hollow.

9. The thermometer in accordance with claim 1 wherein said temperature sensor is a thermistor.

10. The thermometer in accordance with claim 1 wherein said temperature sensor is a thermocouple.

11. The thermometer in accordance with claim 1 wherein the digital display is a liquid crystal display.

12. The thermometer in accordance with claim 1 wherein a battery is operably associated with said processor as a power source to energize the processor.

13. The thermometer in accordance with claim 1 wherein said housing is rigid.

14. The thermometer in accordance with claim 1 wherein said housing is flexible.

15. A thermometer suitable for measuring the temperature of a patient and comprising:

an elongated shell;

a flat, flexible probe mounted to said shell and extending outwardly from one end thereof;

a temperature responsive-element at the distal end of said flat probe;

a digital display in said shell; and

an electronic processor in said shell operably associated with said temperature-responsive element and with said digital display to convert a temperature value detected by said temperature-responsive element into a read-out on said digital display.

16. The thermometer in accordance with claim 15 wherein said flat, flexible probe defines a ridge, suitable for engagement by the teeth of said patient.

17. The thermometer in accordance with claim 15 wherein a major portion of said flat, flexible probe has a width-to-thickness ratio of at least about 5.

18. The thermometer in accordance with claim 15 wherein said flat, flexible probe has a width that tapers away from said shell.

19. The thermometer in accordance with claim 15 wherein said flat, flexible probe has a sensor cap covering said temperature sensor.

20. The thermometer in accordance with claim 15 wherein said electronic processor is operably associated with said temperature sensor by means of a conductor constituted by plural metal strips carried by said flat, flexible probe.

21. The thermometer in accordance with claim 15 wherein said shell is rigid.

22. The thermometer in accordance with claim 15 wherein said shell is flexible.

23. The thermometer in accordance with claim 15 wherein said shell is made of an elastomeric material and encapsulates said electronic processor.

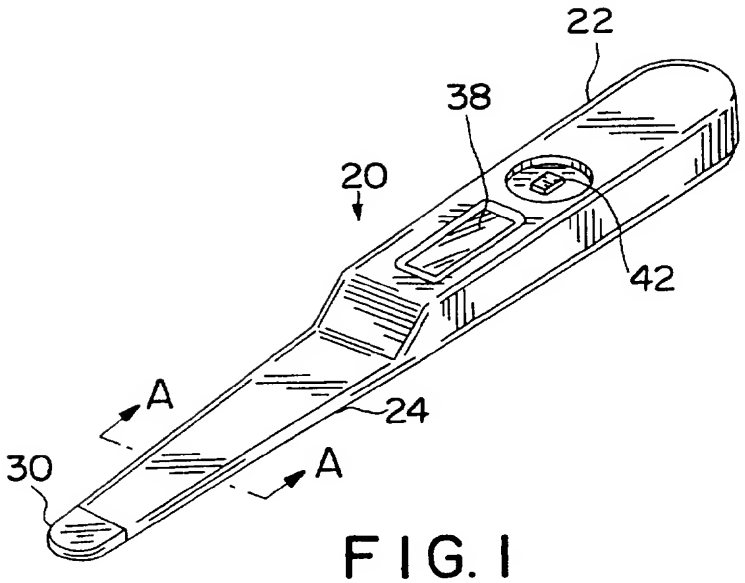

FIG. 1

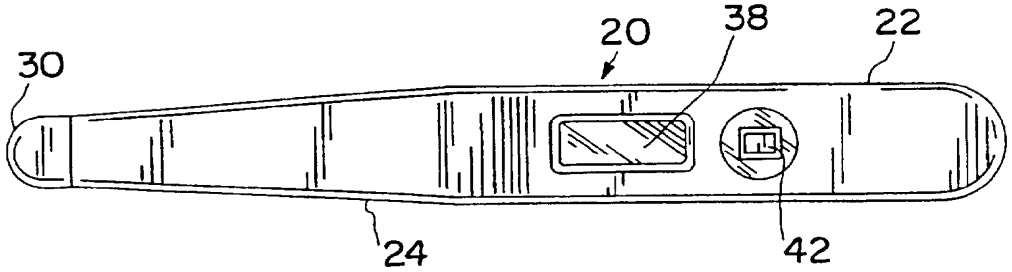

FIG. 2

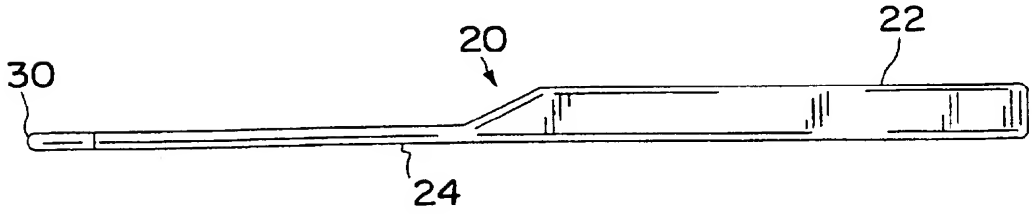

FIG. 3

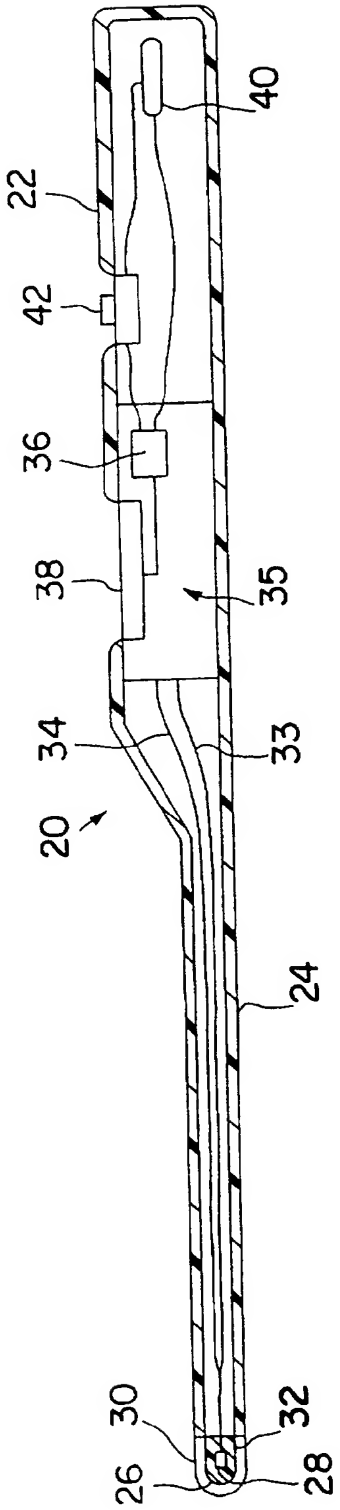

FIG.4

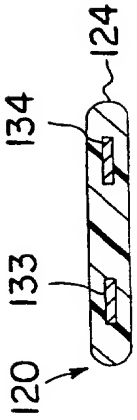

FIG.5

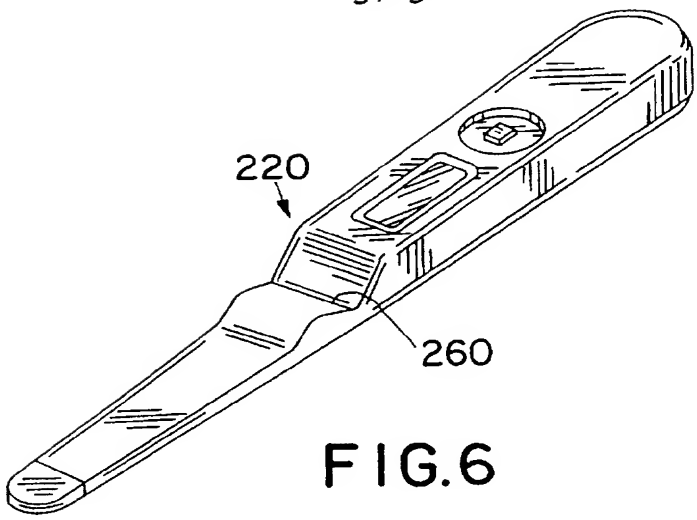

FIG.6

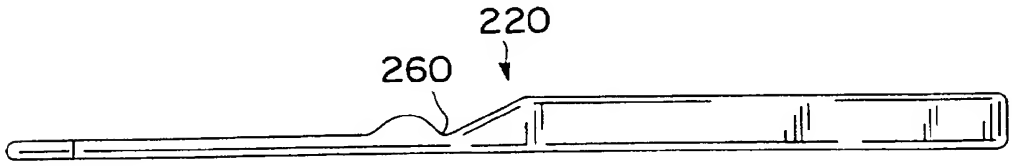

FIG.7

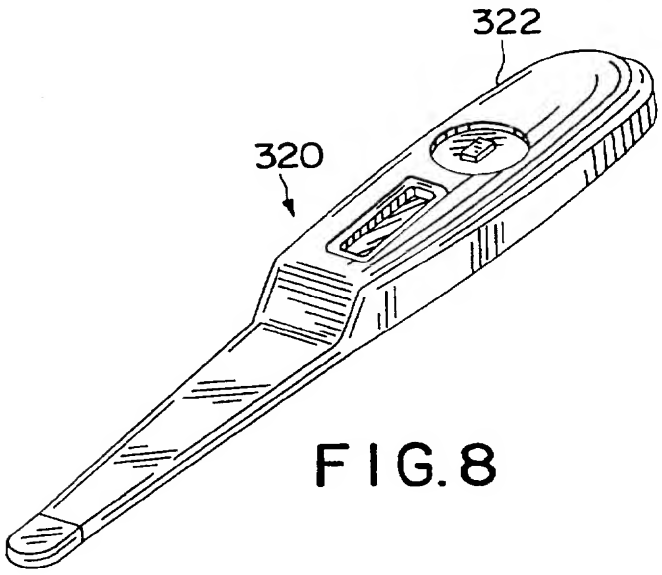

FIG.8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/19822

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G01K 1/00, 1/08; G01K 7/00
US CL : 374/208, 170; 128/736
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 374/208, 170, 163, 179, 183; 128/736

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	JP 402262025 A (AIBA) 24 October 1990, see entire patent.	1-4,8,11,13-19 ----- 5-7,9,10,12,20-23
Y	US 4,743,121 (TAKAGI et al) 10 May 1988, see entire document.	5-7,9,12,20-23
A	US 5,013,161 (ZARAGOZA et al) 7 May 1991, see entire document.	

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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